Tsukuba 32-m VLBI Station

Daisuke Tanimoto, Shinobu Kurihara, Kensuke Kokado, Shigeru Matsuzaka

Abstract

The Tsukuba 32-m radio telescope is operated by the Geographical Survey Institute (GSI) VLBI group. This report summarizes the current status and the future plans of the Tsukuba 32-m VLBI station.

We participated in a total of 208 domestic and international VLBI sessions in accordance with the IVS 2008 observing plan. The CONT08 campaign in August was the highlight of the year. In experimental sessions in 2008, we achieved an extremely rapid UT1 measurement latency of 3 minutes 45 seconds for an ultra-rapid dUT1 experiment in February. We started 32 Mbps/ch observing using K5/VSSP32 this year.

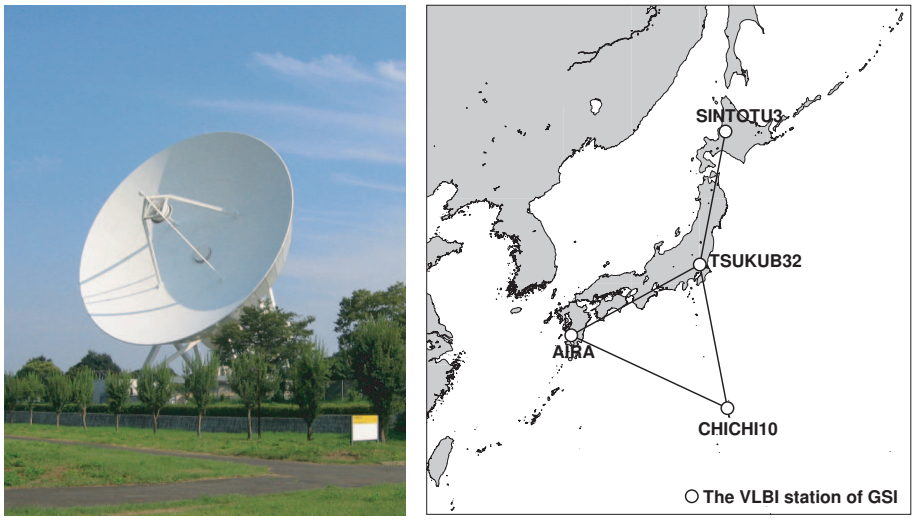

Figure 1. Tsukuba 32-m VLBI station and GARNET (GSI VLBI network).

1. General Information

The Tsukuba 32-m VLBI station (TSUKUB32) is located at GSI in Tsukuba Science City, which is about 50 km to the northeast of the capital Tokyo.

GSI has four VLBI stations; TSUKUB32, AIRA, CHICHI10, and SINTOTU3. These four stations form our domestic VLBI network named GARNET (GSI Advanced Radio telescope NETwork). We have performed our domestic VLBI observations using GARNET. One series of sessions is named JADE (JApanese Dynamic Earth observation by VLBI). The main purposes of the JADE series are to define the reference frame of Japan and to monitor the plate motions for the advanced study of crustal deformations. The GARNET stations, centered on TSUKUB32, are located to cover the Japanese mainland. The GARNET stations other than TSUKUB32 joined international VLBI sessions this year.

2. Component Description

In 2007, we completed the installation and adjustment of K5/VSSP32, which enables us to record at up to 32 Mbps/ch. In April 2008, we started observing with the recording speed of 32 Mbps/ch. It is possible for us to sample 32 MHz/1-bit data and 16 MHz/2-bit data. We modified some related scripts in K5 and FS computers for 2-bit sampling. K5/VSSP32 is working well now.

We have an "e-VLBI" network which is capable of transferring the huge amount of VLBI data with a high transfer rate. In 2007, we started e-VLBI transfers in practice. In September 2008, the Tsukuba e-VLBI network joined SINET3 (the Science Information NETwork 3) and renovated some equipment. We have been regularly transferring VLBI data via the e-VLBI network from/to the Bonn correlator, the Wettzell station and the Haystack observatory. The transfer rate between Tsukuba and Bonn is 600 Mbps now.

In December 2008, we introduced a remote-control switch which can change the wiring of the backend IF cable. We added remote-control of the switch to the Field System; therefore we do not need to set up the wiring before observations manually now. This means that we can observe continuously automatically, for example, for the case of IVS-R1 (X-band: wide) and IVS-T2 (X-band: narrow, 30 minutes after R1). It is very convenient, because the start time of these sessions is midnight in Japan.

3. Staff

Table 1 shows the regular operating staff of GSI's VLBI observation group.

Morito Machida (former operation chief) moved to a different section and Etsurou Iwata (former network chief) retired from GSI in April. Kazuhiro Takashima came back to GSI as a senior researcher after a year. He is a member of the IVS Directing Board (Networks Representative). Yasuko Mukai came as the new staff member for routine observation and correlation. Routine operations were mainly performed under contract with Advanced Engineering Service Co., Ltd (AES).

The information on the correlator staff are listed in the correlator section of this volume.

Table 1. Staff list of the GSI VLBI group

Name	Position
Shigeru MATSUZAKA	Head of Space Geodesy Division
Kozin WADA	Deputy head of Space Geodesy Division
Shinobu KURIHARA	Responsible official
Kensuke KOKADO	Technical staff (Observation and Analysis)
Daisuke TANIMOTO	Technical staff (Observation)
Yasuko MUKAI	Technical staff (Observation and Correlation)
Toshio NAKAJIMA	Network staff
Yoshihiro FUKUZAKI	Technical manager
Kazuhiro TAKASHIMA	Senior researcher, IVS DB

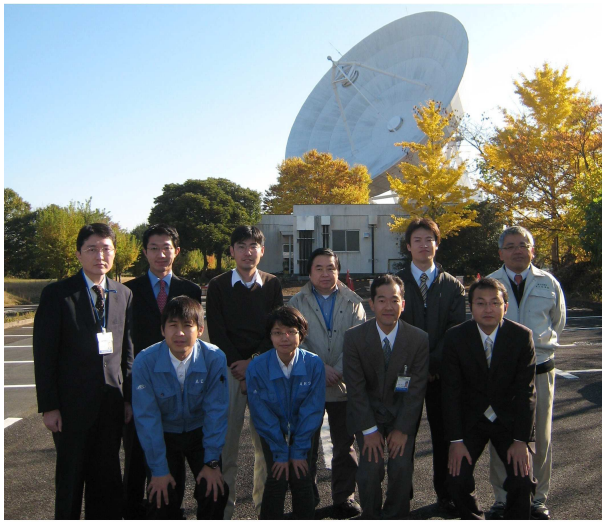

Figure 2. VLBI member group photo

4. Current Status and Activities

The regular sessions from the IVS 2008 master schedule are shown in Table 2. TSUKUB32 participated in a total of 208 domestic and international VLBI (IVS) sessions in this year.

CONT08 is a two week campaign of continuous VLBI sessions. We participated in this challenging campaign during the second half of August. The recording speed was 32 Mbps/ch. We observed by K5/VSSP32. Two IVS-R&D sessions provided a test of the 32 Mbps/ch recording before CONT08. Since CONT08, the live camera page for the Tsukuba 32-m VLBI antenna has been uploaded to our Web site at:

http://vldb.gsi.go.jp/sokuchi/vlbi/en/antscan/index.php

Additionally, we participated in one IVS-OHIG session for the first time in November.

In the past, TSUKUB32 had been the only one of the GARNET stations to participate in international VLBI sessions. This year, AIRA and CHICHI10 joined IVS-T2 sessions, and AIRA, CHICHI10, and SINTOTU3 joined APSG sessions. This means that AIRA, CHICHI10 and SINTOTU3 have connected to the international VLBI network directly.

We changed the frequency sequence from X8/S8 to X10/S6 starting in the November JADE session. The increased X-band channels are LSB of channels 1 and 8. This is the same as international VLBI sessions such as IVS-R1 and IVS-T2. Moreover, we performed the 2-bit sampling in the November JADE session.

Table 2. The regular (IVS) sessions at Tsukuba 32-m VLBI station in 2008

Sessions	Codes	Number
IVS-R1	r1310, r1313, ... , r1357	31
IVS-T2	t2053, t2055, t2058, t2059	4
APSG	apsg22, apsg23	2
VLBA	rdv67, rdv71, rdv72	3
CONT08	c0801, ... , c0815	15
IVS-R&D	rd0803, rd0804	2
IVS-OHIG	ohig60	1
JADE	jd0801, ... , jd0808, jd0811	9
IVS-INT2	k08005, k08006, ..., k08363	99
IVS-INT3	k08042, k08049, ..., k08357	42
Total		208

The experimental sessions in 2008 are shown in Table 3.

We carried out a total of 18 (4 days) ultra-rapid dUT1 experiments in this year. Ultra-rapid dUT1 experiments are experimental sessions using e-VLBI technology. We observed using the baseline between Japan (Tsukuba and Kashima) and Fennoscandia (Onsala and Metsähovi). The huge amount of VLBI data is transfered from Fennoscandia to Japan near real-time. The goal is to obtain the UT1 results as rapidly and as stably as possible. We succeeded in obtaining dUT1 only 3 minutes 45 seconds after the end of the observing session with Onsala on Feb. 21, 2008. Since April, we have recorded 32 Mbps/ch with a 512 Mbps transfer rate.

GSI and NICT (National Institute of Information and Communications Technology) are developing a compact VLBI system with a 1.6 m diameter aperture dish (MARBLE; Multiple Antenna Radio-interferometry of Baseline Length Evaluation) in order to provide reference baseline lengths for GPS and EDM calibrations. We have evaluated a front-end system with a wide-band quad-ridged horn antenna (QRHA) by installing it on the 2.4 diameter dish at Kashima (CARAVAN2400). Three geodetic VLBI experiments on the 54 km baseline between the Tsukuba 32-m and CARAVAN2400 with the QRHA were carried out, and we succeeded in obtaining the baseline length results.

In addition, we performed special geodetic VLBI sessions in January and June intended for determining more precise positions for the UCHINOUR and USUDA64 antennas owned by Japan Aerospace Exploration Agency (JAXA).

Table 3. The experimental sessions at Tsukuba 32-m VLBI station in 2008

Session	Code	Number
Ultra-rapid dUT1 experiment	u8052t, u8052a-d, u8113a, u8113b, t8193a-f, u08245s, u08245a-c, k08245	18 (4 days)
UCHINOUR geodetic experiment	u08020	1
USUDA64 geodetic experiment	u08170	1
CARAVAN2400 geodetic experiment	ca8121, ca8175, ca8184	3

We performed a local tie survey at TSUKUB32 in February and at AIRA in October and November.

5. Future Plans

Tsukuba 32-m, AIRA, CHICHI10 and SINTOTU3 will also participate in many IVS sessions in 2009. To keep getting high quality VLBI data, we will try to renovate and improve our VLBI equipment. We have obtained the necessary budget for renewing a current hydrogen maser and for purchasing a high-speed digital sampler "ADS3000 plus". Furthermore the working prototypes of the MARBLE system will be completed, and we will be able to carry out test geodetic VLBI experiments using the MARBLE system in 2009. As for our network infrastructure, speeding up of the SINET3 is under consideration.